

Things to Look For In a Commercial 3D Model

Browsing through online 3D model sites can be a quick path to your destination when you need a model for 3D-printing, rendering still shots, or animation.

The first question I ask when presented with any 3D job --whether it's animation-related, shots for still renders used in technical illustrations or custom work is, "What's the deadline?" followed by the budget size. If either is unrealistic, the process abruptly ends. The old phrase, "You can have it right, fast, or cheap. Pick one." certainly applies.

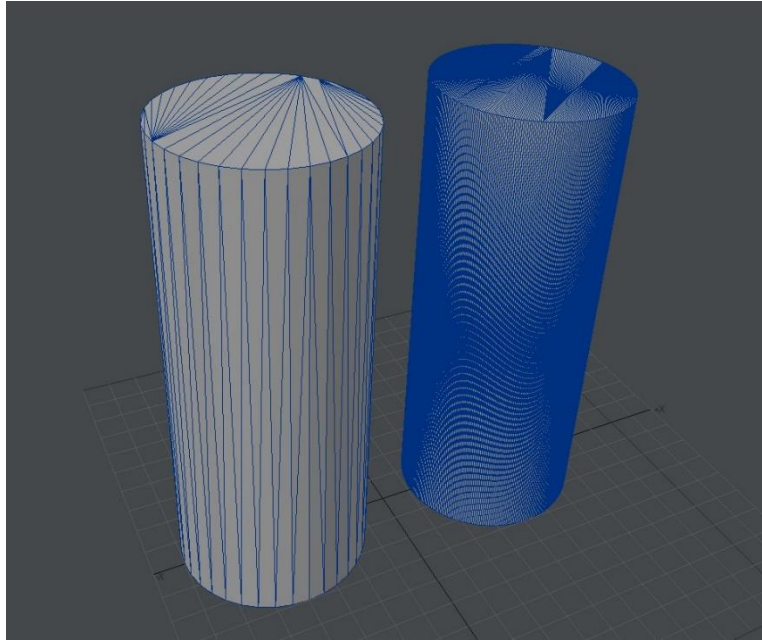
Before generating an estimate, the kind(s) of 3D assets to fulfil the requirements of the job need to be determined. Sometimes in-house generated engineering CAD models are available. These usually need to be optimized for texturing and rendering so the finished work looks as photo-realistic as possible. Other times, a ready-to render asset is purchased to save time using supplied textures I can modify with Photoshop.

CAD models are notorious for generating very high-count, polygonal 3D models. During CAD modeling, polygon count is irrelevant. To the CAD jockey, the model is displayed as a series of simple interconnected lines and curves. Rounded edges, (also known as fillets) are usually displayed as two offset lines with curves at each end to denote width and slope.

When a completed model is exported as a 3D printer-friendly file, (usually in STL format) the smoothness of the object's surface is established. In Fusion 360, this setting is called "Refinement" and has four settings: Low, Medium, High, or Custom. The Low setting gives the least resolution and the lowest polygon count, which may (or may not) be suitable for the job.

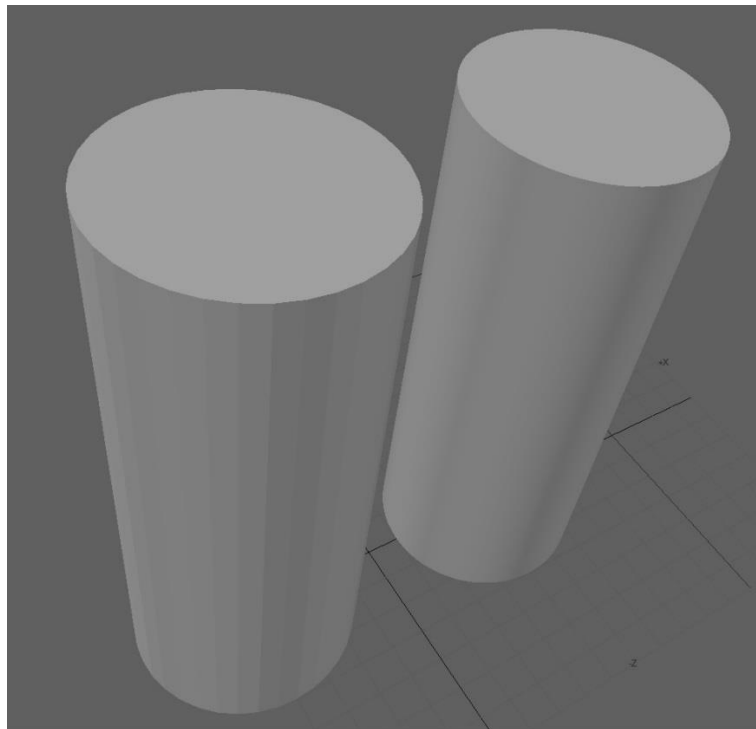
Surface smoothness directly affects polygon count. Set too low, the printed 3D object can look like it was carved out of wood with a dull knife. Set too high, and the slicer that interprets the 3D object code into tool code may bog down, crash, or take longer to print.

3D printer heads move in a series of line segments. A circle with 36 sides has 36 line segments; the same-sized circle with 360 sides has 360 line segments. Both are round, but one will look smoother than the other when extruded as a 3D object.



(Figure 1. 36-Sided Cylinder and 360-Sided Cylinder Polygon Comparison)

In figure 1, the 36-sided cylinder has 140 polygons or faces. The 360-sided cylinder adjacent to it contains 1436 polygons. All polygons are made of 3-point triangles.



(Figure 2. Faceting Comparison)

To further illustrate the point, Figure 2 shows the same cylinders without the “wires” just as they would appear when printed. Notice the jagged edge on the top and bottom of the 36-sided cylinder compared to the other with 360 faces? The transition between polygons is much more noticeable and the vertical lines stand out. This is called faceting. It is the biggest determining factor for much time you will spend preparing a 3D-printed part for painting.

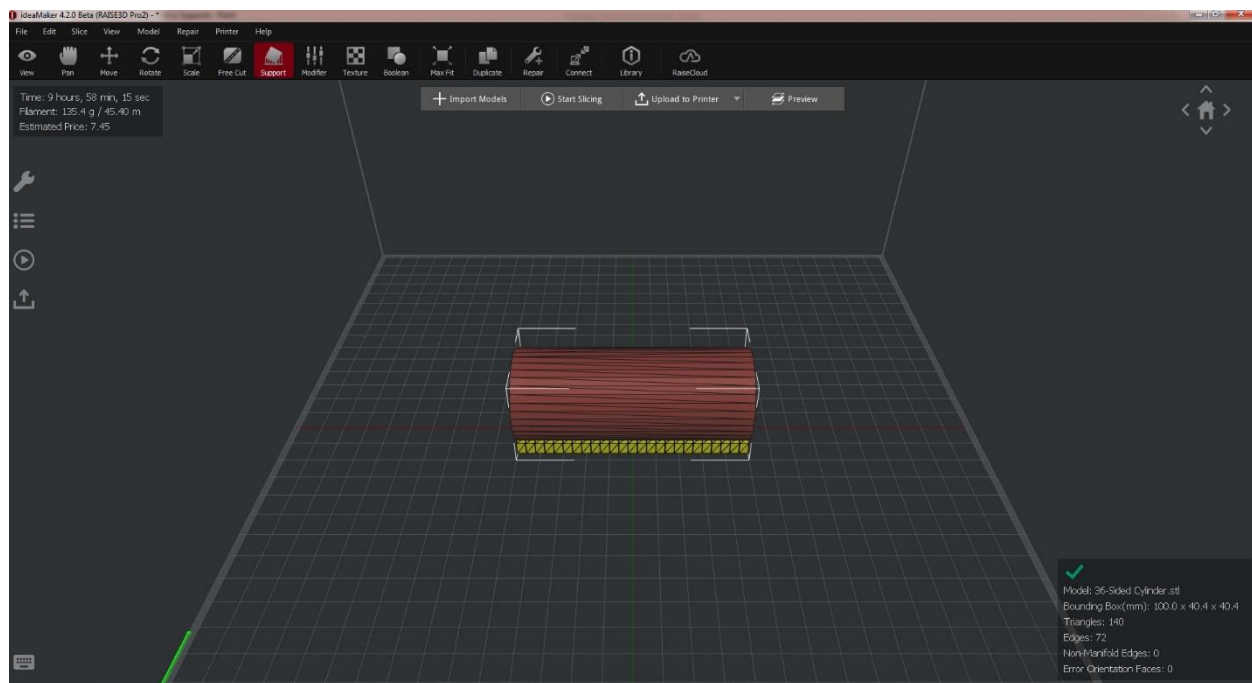
Dedicated slicing software cannot smooth out faceted geometry!

The following figures show ideaMaker-sliced examples of both cylinders. The 36-sided cylinder prints slightly faster than a 360-sided cylinder of equal length. (The long slicing times are due to 100% infill, meaning they’re both solid objects.)

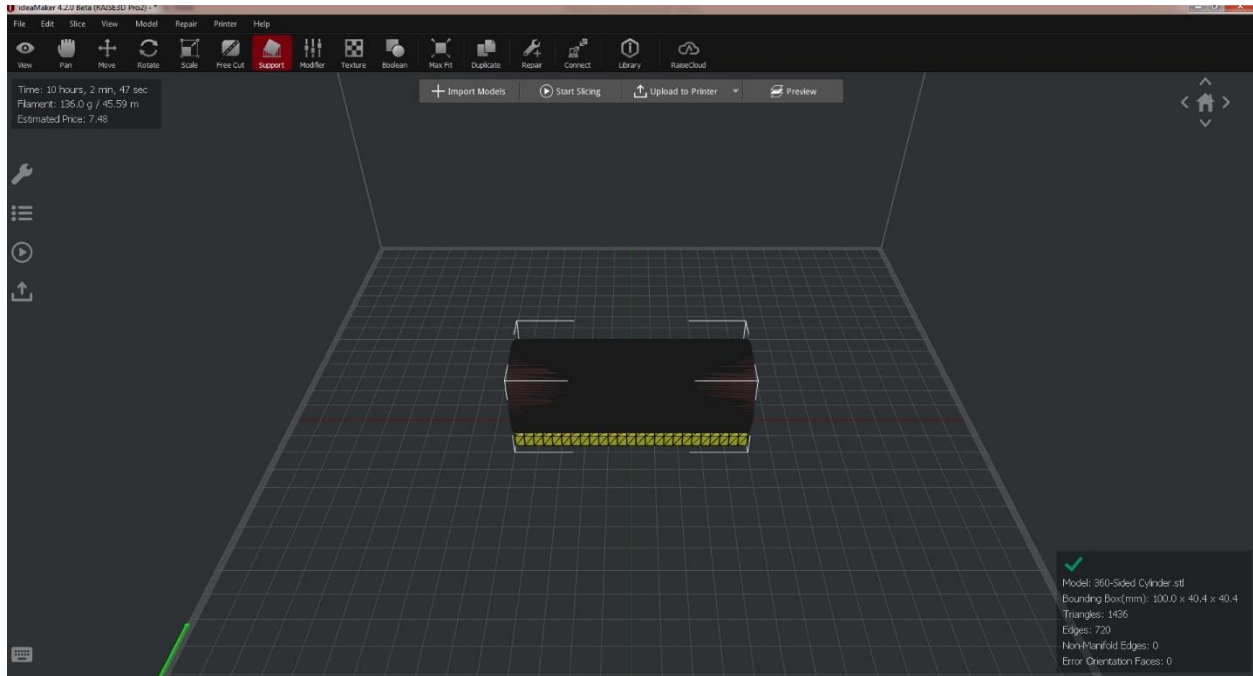
The estimated print time is displayed in the upper/left corner.

Three minutes may not seem like much of a difference, but this is a simple shape. As the shape complexity increases, (more geometry equals more line segments) the print time follows.

Caveat: The info I’ve provided for print time is different for resin printing. That’s another subject for a later post for those who may be interested in a FDM-to-Resin slicing and printing comparison.



(Figure 3. Slicing Summary for a 36-Sided Cylinder)



(Figure 4. Slicing Summary for a 360-Sided Cylinder)

If you remember anything from this read, this next sentence is it:

An optimally-designed 3D model for 3D printing contains the minimum number of polygons that produces an acceptably smooth surface requiring the least amount of surface preparation time.

When you purchase and directly use files “suitable” for 3D printing, you get what you get. If you have the ability to create or modify 3D models, -depending on the software you use, you have complete control over the finished product.

There are many commercial online sites offering 3D models in a wide variety of prices and build quality levels. When I’m under a tight deadline for a project, (or estimating my labor and material costs) I often shop online. If I’m using an in-house CAD-generated engineering model, I still have to slim down the polygon count, which is almost as time-consuming as building the object from scratch. But if I need a highly-detailed vehicle or something that isn’t in my extensive library, purchasing a \$400 model can easily save me weeks of modeling, which is a lot cheaper than paying for my labor. Even with this cost-saving advantage, I have to evaluate many similar-looking models to ensure the best bang for the buck is obtained for the customer.

I'll share some of the criteria I use to ensure the file I paid for doesn't end up costing more than the time and money it was intended to save. The same criteria is helpful when buying 3D files for printing. You don't always get what you pay for.

The following examples are taken from the biggest commercial 3D model site on the internet called "Turbosquid". Go to the site, type "submarine" in the search field and you might see something you like.

Once you know what to look for, it's easy to spot over-priced models, (and there are a lot of them!) A model that looks good with a texture, (painted exterior) applied, may really be highly faceted when the texture is removed and the lines of the 3D mesh are visible. Good texturing often hides poor modeling. You'll see many submarines posed in a 3D ocean environment – this is another method to disguise or compensate for a bad mesh. Some modelers don't show the mesh or render the shot far enough away to make it difficult to see how it's actually constructed. For me, no wires means no sale. Even if the modeling isn't ideal, viewing the wires / mesh makes it easier to decide whether I should expend the time to make it presentable.

With some freely-available 3D software, you can buy a submarine, cut it into printable sections sized for your printer, thicken the hull and create a model to print. That's a simplistic description, but we'll explore this in more detail during future modeling tutorials. I don't want to stray off the subject and Jedi mind-cloud your brain at this point.

To summarize: Efficiently-built 3D models, (whether you build or buy them) print faster and with higher surface quality minimizing the amount of valuable time spent preparing them for painting.

The following examples will describe some of the details to be aware of that may save you time and money – unless you have an over-abundance of either and don't care.

Example 1: The "Game-Ready" Model

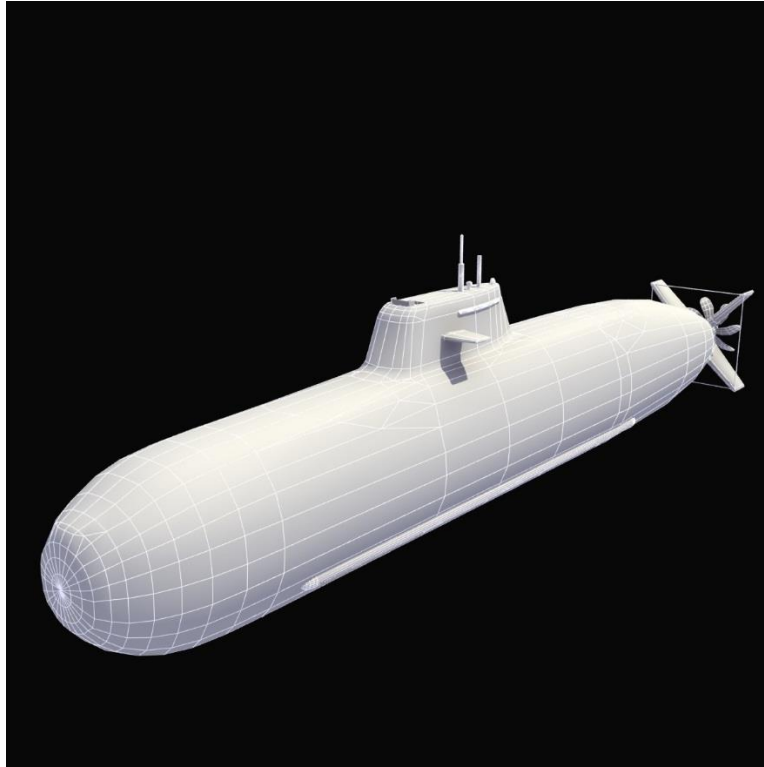
One of the key performance ratings of game engines and video game consoles is how many triangles per second (TPS) they process. Triangles are the simplest polygons for a computer to digest. They are also blessed with never being non-planar. Move any of the points in any direction and a triangle remains a flat plane.

Move a point in any polygon with more points –quads (four-point polygons) or polys with more than four points, and they are “bent” – or not flat. Computers cannot process curved polygons properly, only flat planes. This is why objects in games as well as STL files for printing are always made of triangles. Test on Friday.

The following submarine model has a low poly count, optimized for a gaming engine to get the smoothest video possible at the expense of close-up detail. They also make very poor printed models, so you’re advised to steer clear.



(Figure 5. Textured - Type 209 Submarine)



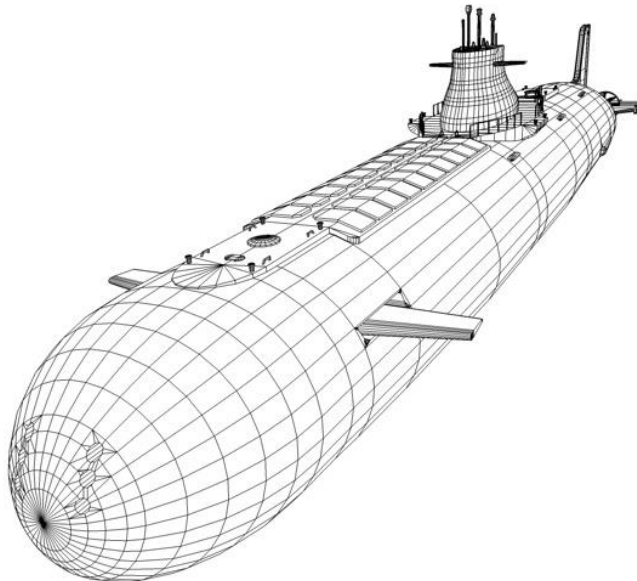
(Figure 6. Shaded Wire - Type 209 Submarine)

The dead give-away for a game-ready model are the faceted edges of the bow and stern and the hard-edged silhouette. The model may be advertised with four-point polygons, but ultimately it will be all triangles, and there aren't enough of either to make this a good 3D printing candidate.

Example 2: The “Cartoony” Model



(Figure 7. Textured View)

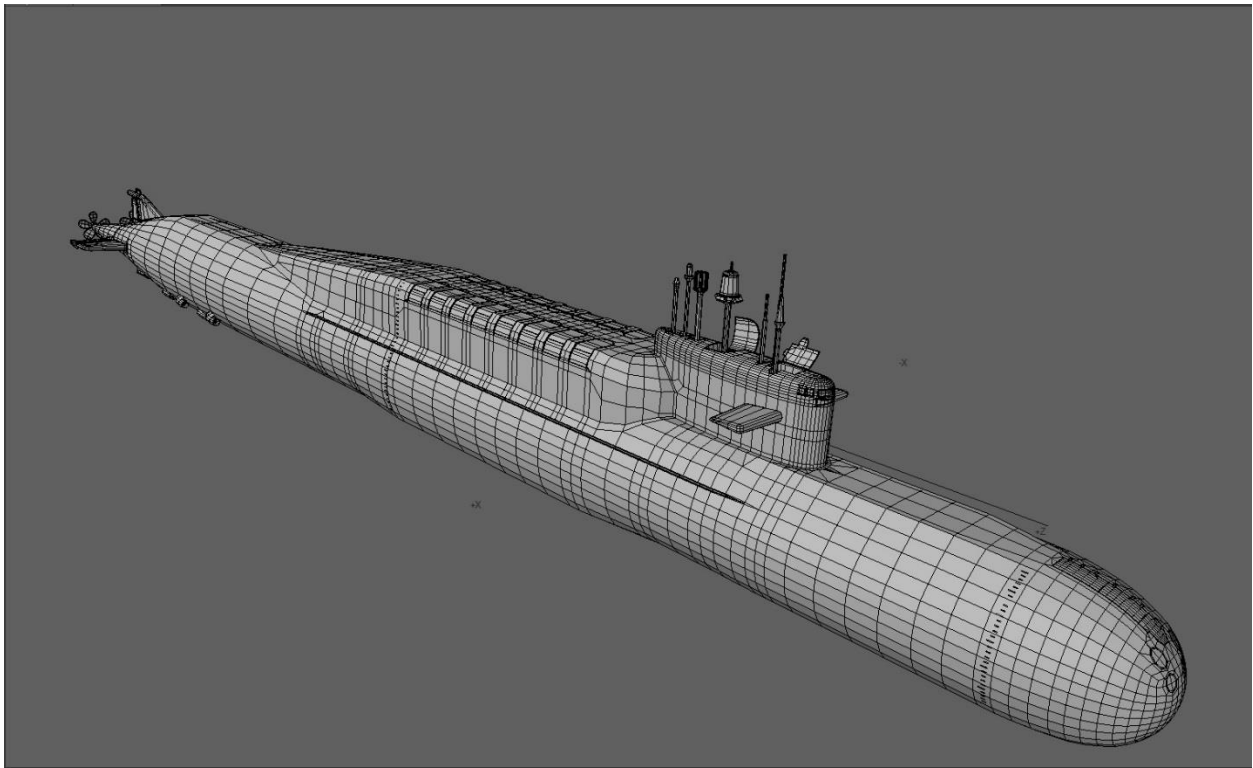


(Figure 8. Shaded Wire View)

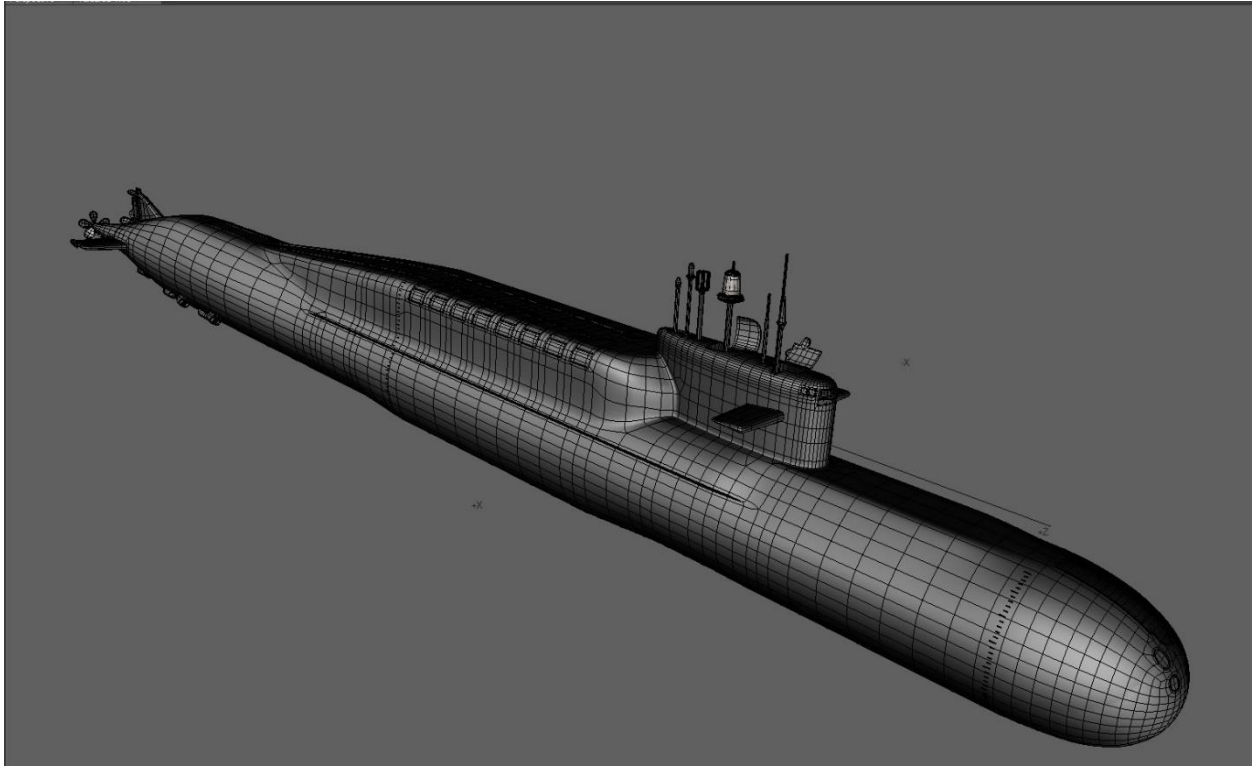
Figures 7 & 8 show the creation of a modeler with either a sense of humor, and/or minimal modeling skills. No realistic reference material was used, but its close enough that I suspect it's a skill set issue and useful only for games. Basically, it looks like a cartoon version of the world's largest submarine. Bow *and* sail planes?!! Nothing to see here . . . save your shekels and move along.

The Faceted Delta

This example of a Delta may or may not work – at least in its present state. It is faceted – though not as much as a game-ready object. Note where the sail and turtleback meet the hull – the transition is straight.



(Figure 9. A Quad-Poly Based Delta)



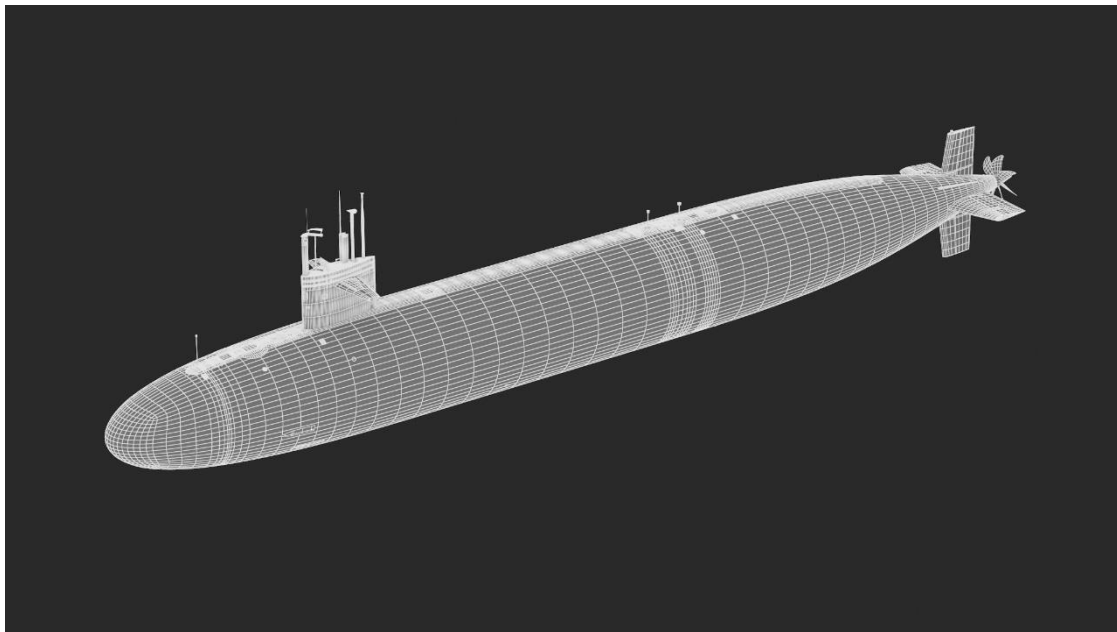
(Figure 10. Delta with Smoothing Applied)

Figure 10 is the same object with a smoothing algorithm applied. It looks cleaner with curved surfaces than the formerly flat quad polygons. In reality, this is a computer-generated smoothing technique used to make renders of lower-polygon objects look more rounded. In reality, if you were to print the model, it would be faceted, like figure 9. To preserve the apparent smoothing, the model you see in figure 10 has to have every polygon sub-divided into even smaller polygons, which easily puts the polygon count through the roof defeating the purpose of efficient modeling. If the software you're using has adjustable subdivision, you might be in luck.

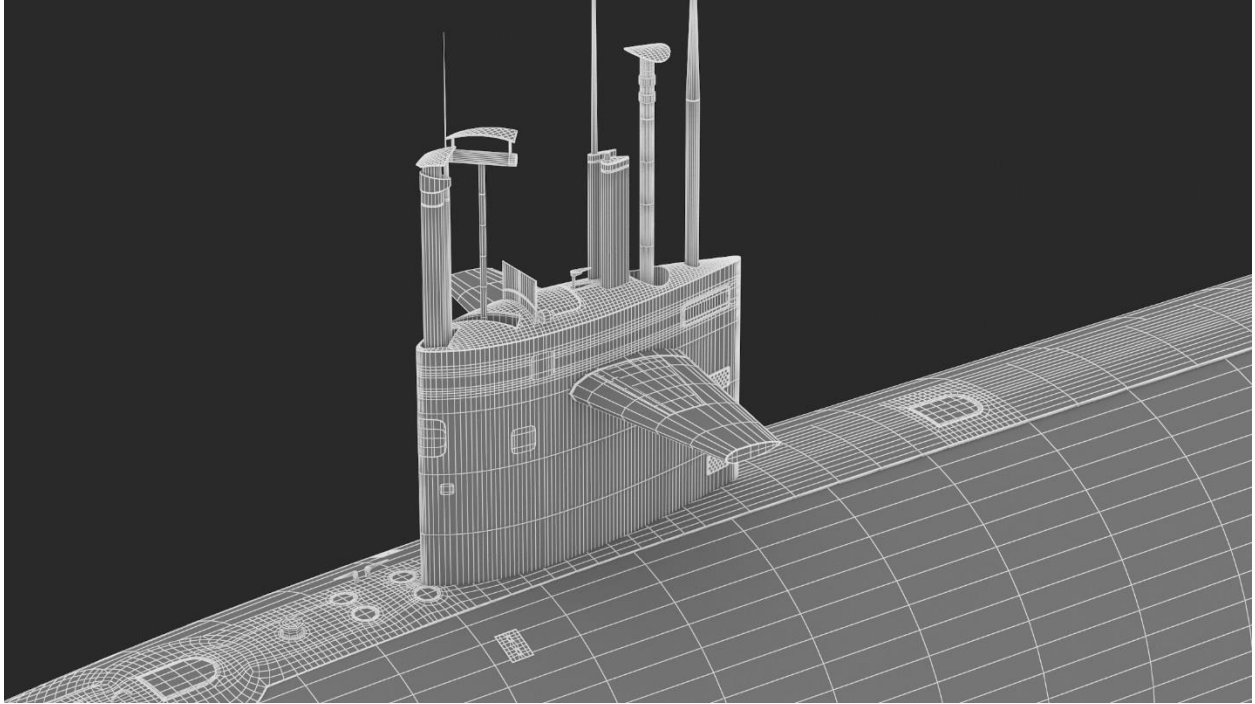
Example 3: The Model to Look For



(Figure 11. Textured Permit)



(Figure 12. Wireframe Permit)



(Figure 13. Wireframe Shaded Sail Detail)

This is more like it! This modeler has created a Permit-class boat with a reasonable polygon count; they are all quads (four-point polys). This is a good skill indicator) which (at least) doubles the polygon count when converted for 3D printing by increasing the sub-division level. (Sub-dividing is a fancy way of saying adding more polygons out of the existing ones.) This was probably similar to the Delta when designed, but the sub-divisions were low enough to make it look smooth. A quad base mesh like this is orders of magnitude easier to modify later if needed.

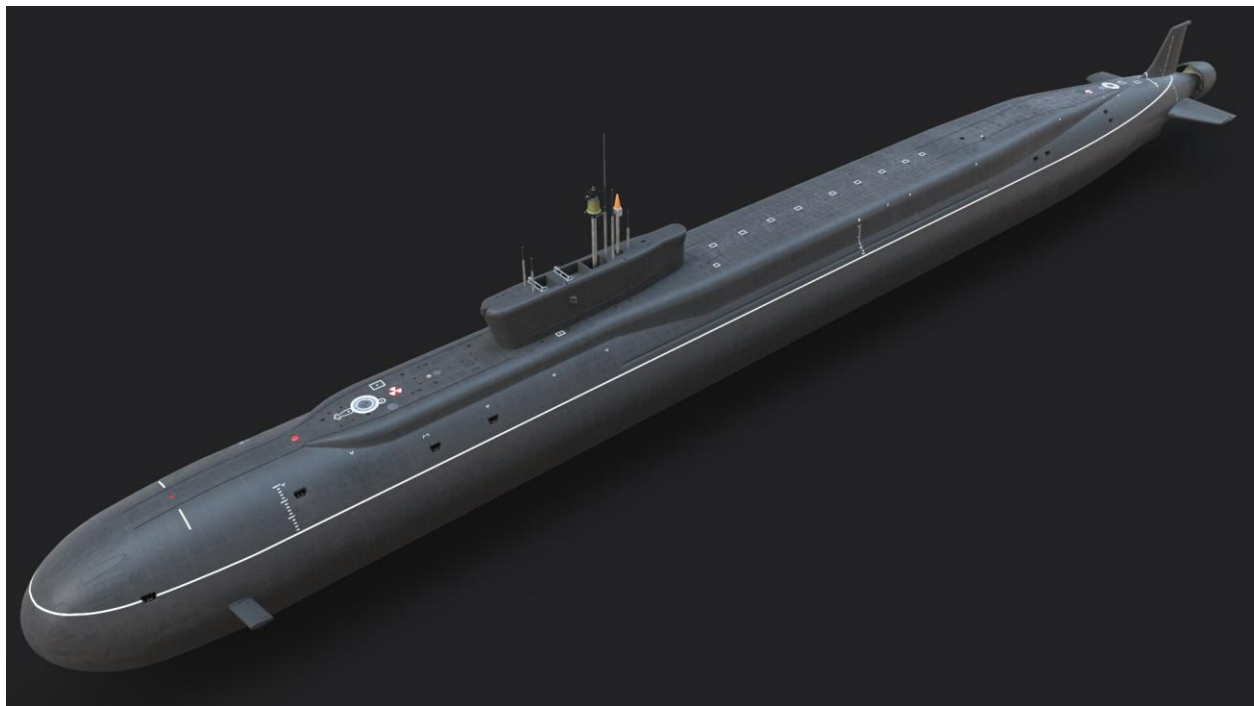
The faceting is controlled and the detail is such that it shows a lot of thought and effort was made to use reference material to build an accurate model. At the right price point, this is worth considering if someone needs a Permit class hull in a hurry. It is easily divided into 3D printer-friendly sections but needs to have the hull thickened – in this condition, it's little more than a 3D, hollow shell.

With CAD-generated file previews, you rarely get, (or need) to see the wireframe views, (or polygon count) of a model. CAD files don't care – it's all about dimensional accuracy. This doesn't mean it's poorly-modeled, but there is no

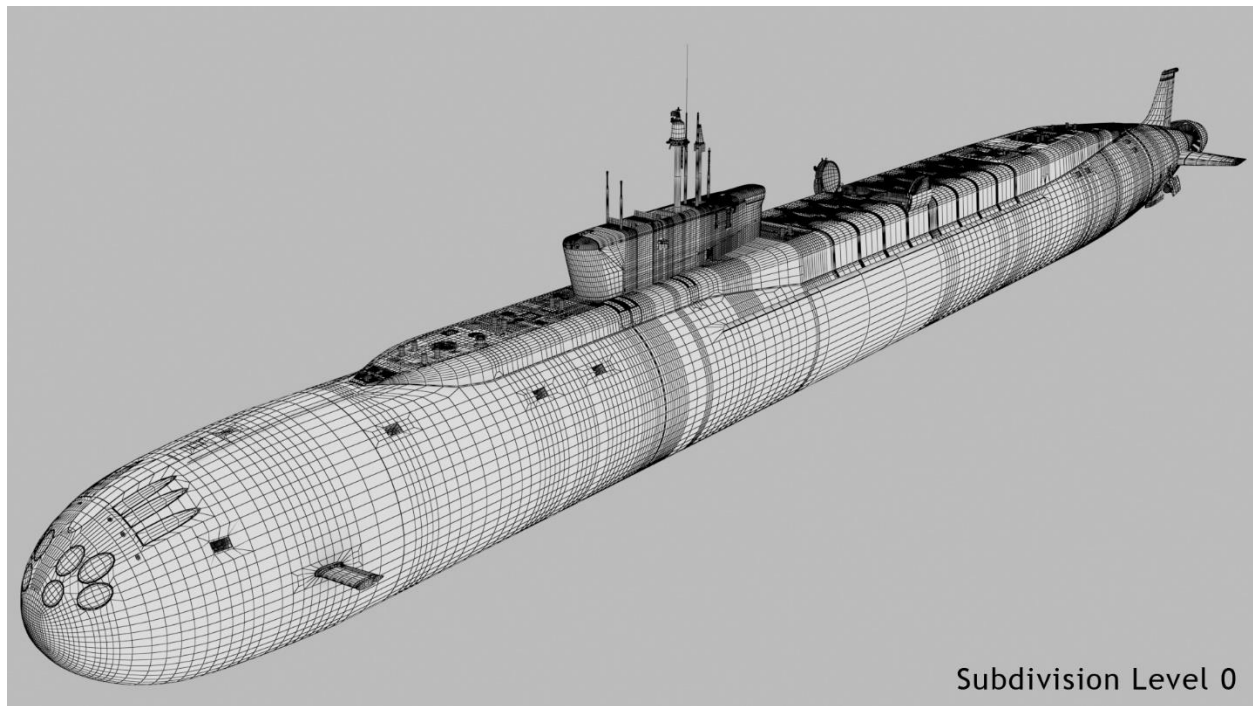
way to verify if the model is faceted until the printer gets busy or the slicer accurately displays the smoothness of the exterior.

Shaded line drawings from CAD files always show smooth curves and flowing lines, so the advertising you see may, (or may not) be what you get. The best indicator of 3D print quality are the build photos many show online. Be aware, a low-quality 3D printer can make even the best modeled hull look bad. For that, there's filler and sandpaper. And time. --Lots and lots of time.

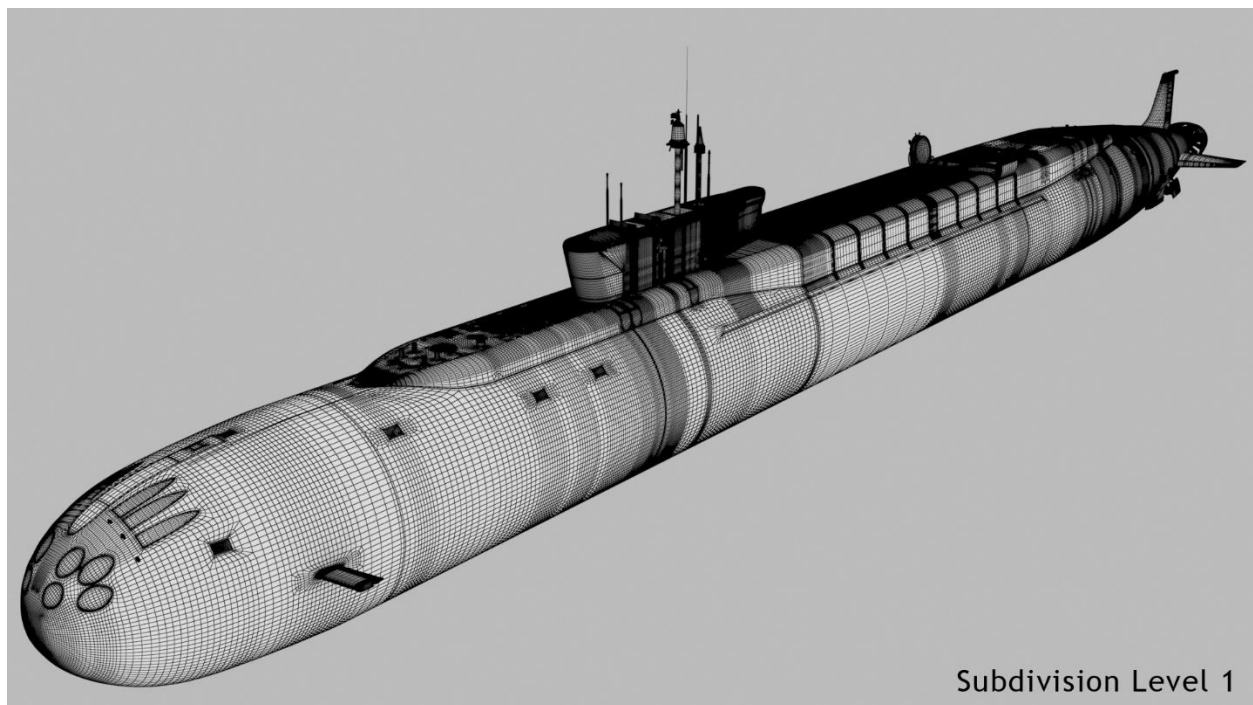
I'll close out with one of the best-looking models I looked at today – for \$400, it's a bargain if a highly-detailed, accurate Borei SSBN model is needed. I'm sure this took quite awhile not only to build, but acquire and pour over the reference material required to accurately produce it. The following figures show comparisons with sub-division levels. The modeler made the extra effort to showcase his creation with excellent renders to educate anyone interested in what they're buying. I've added over 60 shots to my reference library if I ever decide to build it. The texturing is excellent, but it could be improved significantly with weathering. That's an easy job with Photoshop. There are even machining marks on the screw! This is great for a job where a good render is needed, but irrelevant for a 3D printed object.



(Figure 14. Textured Perspective Overview)



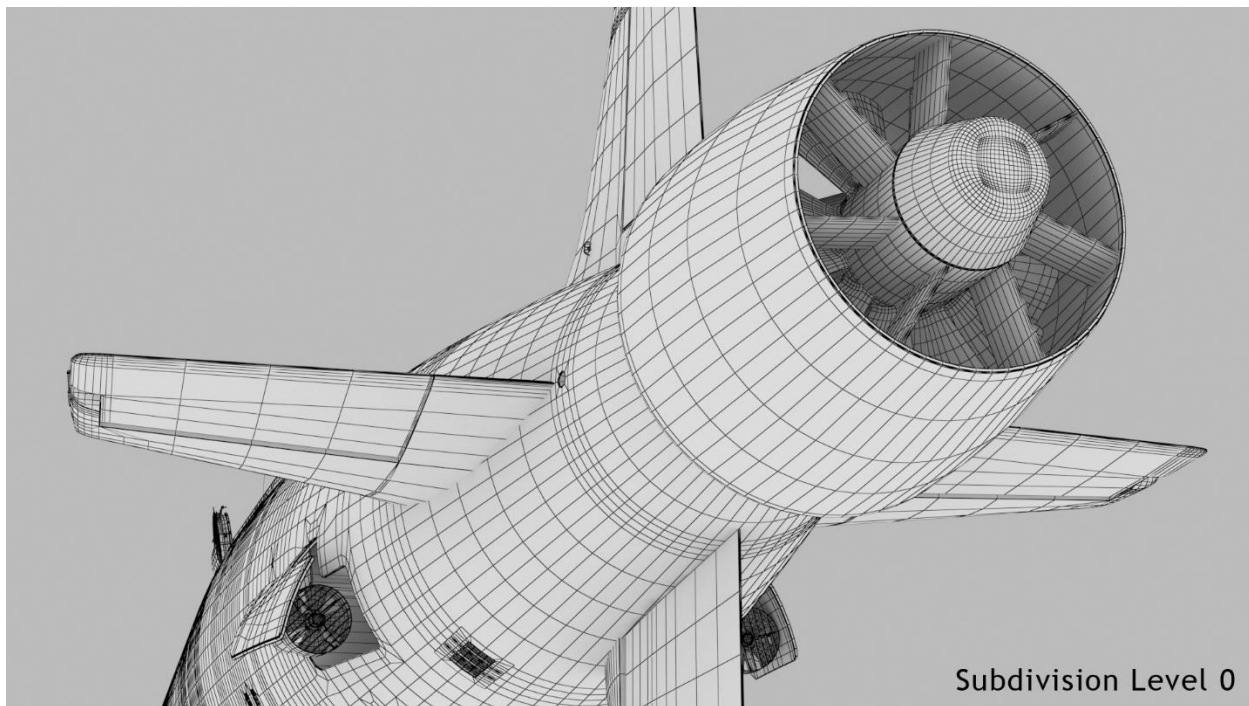
(Figure 14. Wireframe Shade @ SDL 0)



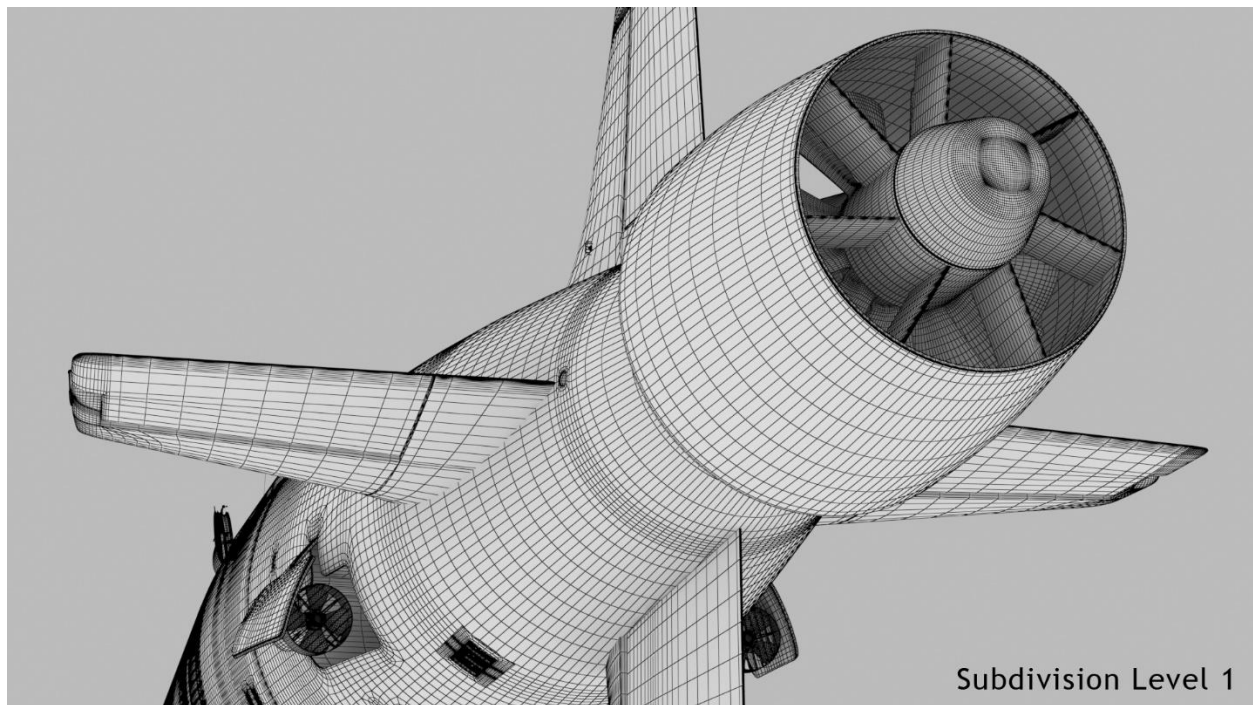
(Figure 15. Wireframe Shade @ SDL 1)



(Figure 16. Textured Stern)



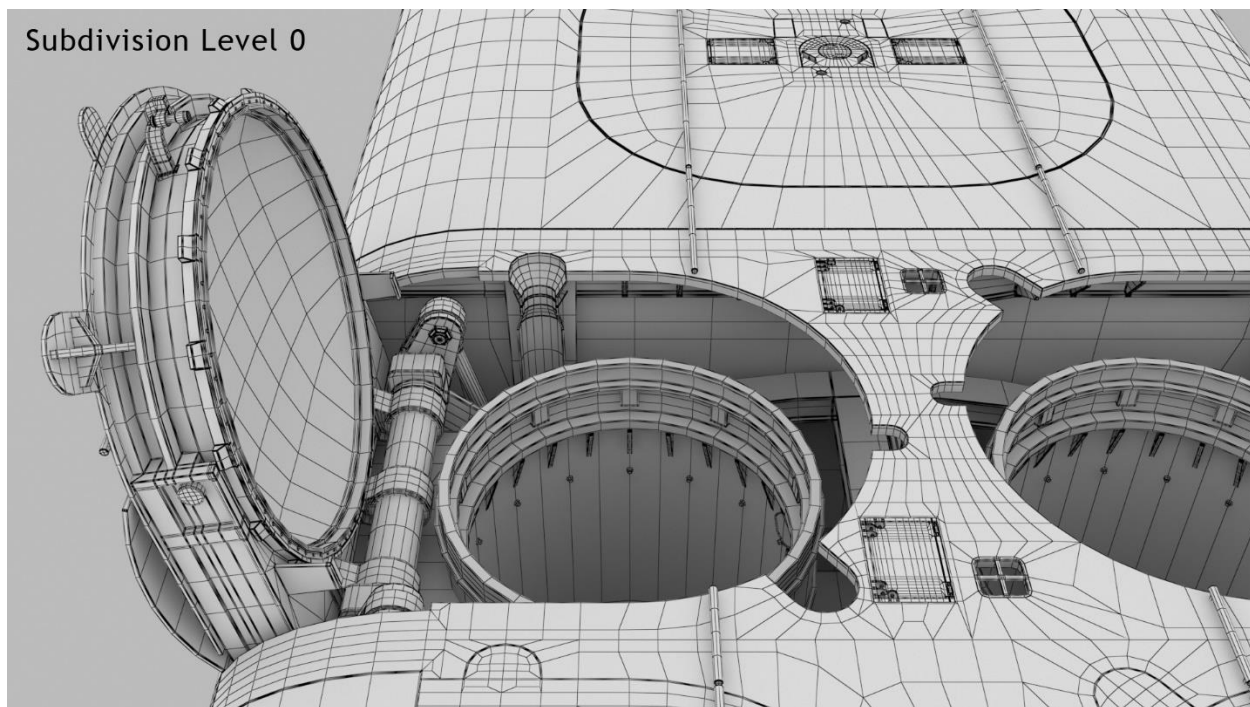
(Figure 17. Wireframe Shade – SDL 0)



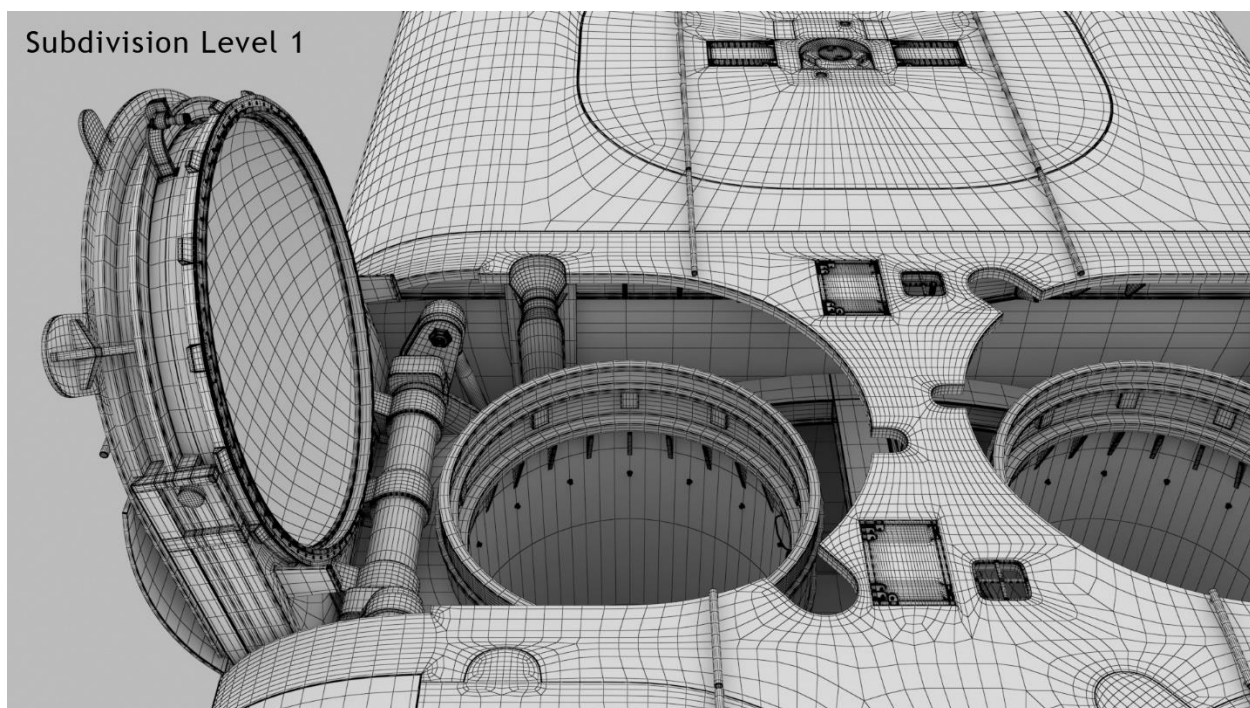
(Figure 18. Wireframe Shade – SDL 1)



(Figure 19. Shaded Solid – Opened Missile Muzzle Hatches)



(Figure 21. Wireframe Shade – Opened Missile Muzzle Hatches - SDL 0)



(Figure 22. Wireframe Shade – Opened Missile Muzzle Hatches – SDL 1)

With your newfound knowledge and keen powers of observation, look at the edge faceting on the top edges of the missile tubes. Each increase in the subdivision level smooths the line segments but also doubles the polygon count. This is a settings adjustment that can be performed within a 3D modeling program. The modeler builds the model with as few polygons as needed to rough out the shape, then increases the subdivision level to add details. This method only works on quad polys.

That's it for this installment. I hope you learned something new, even if you aren't buying or modifying 3D models. Feel free to post any questions (or corrections) if I didn't explain this adequately or you'd like to learn more on this subject.

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